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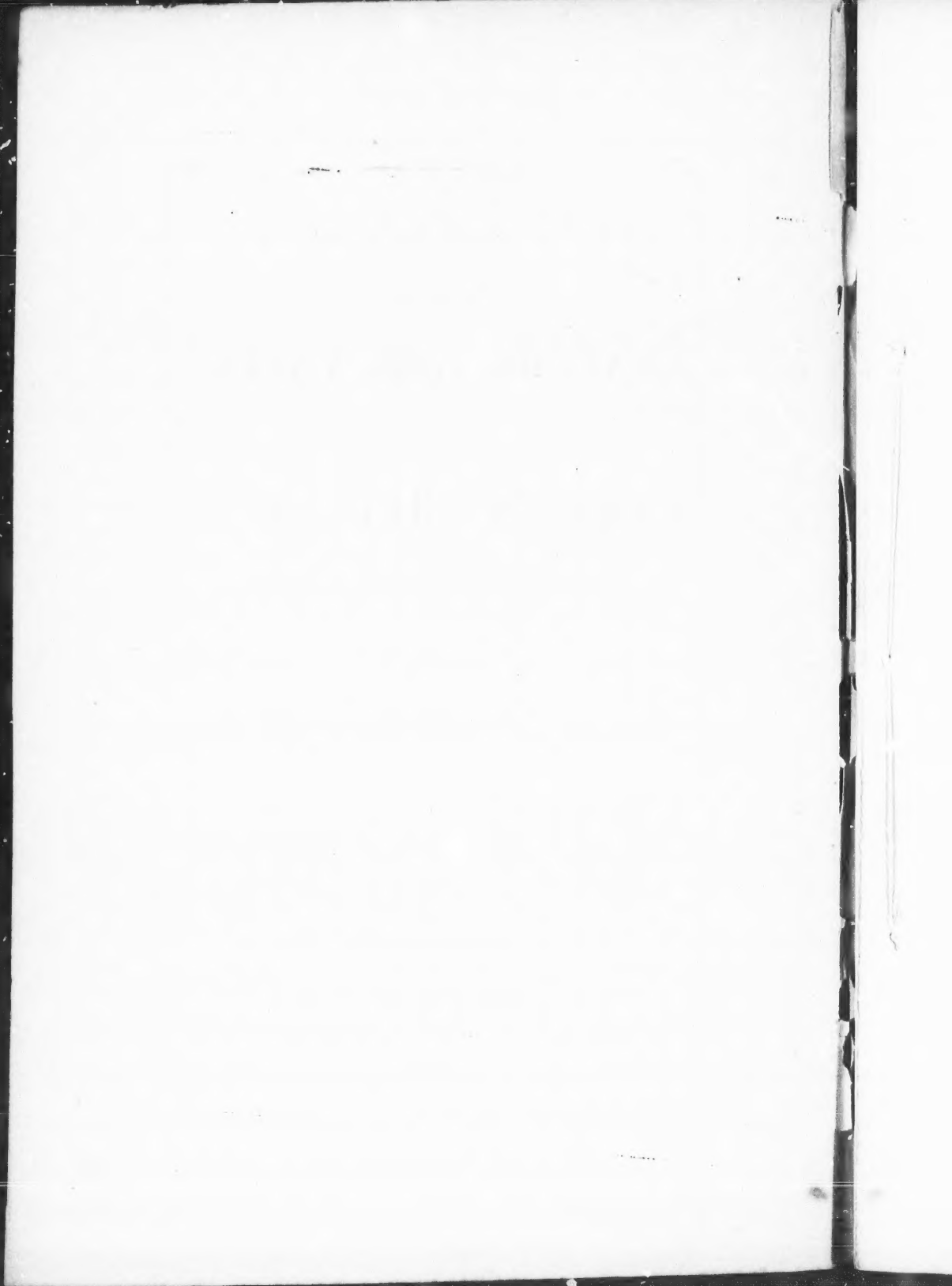
AN INQUIRY
INTO THE
NATURE AND VALUE
OF THE
VARIOUS SHELL MUDS
USED IN PRINCE EDWARD ISLAND,
AS
MANURES AND IMPROVERS OF THE SOIL.



By J. W. TAYLER, Esquire,
FELLOW OF THE GEOLOGICAL SOCIETY OF LONDON.



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Prince Edward Island.

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PETER DESBRISAY,

Assistant Colonial Secretary.

MUSSEL MUD.

An Enquiry into the Nature and Value of Various

SHELL MUDS,

EMPLOYED IN

PRINCE EDWARD ISLAND,

AS

Manures and Improvers of the Soil.

It would be superfluous in these few pages to expatiate upon the advantages of Manures in general. Every farmer is fully cognizant of their importance; still in order to estimate correctly the relative value of the various Shell Muds employed in Prince Edward Island, it will be necessary to compare them with the Manures most familiar to Agriculturalists; and the writer believes that the few pages devoted to their description will embody much useful information, and such as could be, with only some difficulty and research, obtained by the general farmer. Distinction will be made between Manures proper and substances added to improve the texture, or

mineral and chemical properties of a soil. Amongst these latter we should place clay, lime,
* peat, parings, &c.

Of perfect manures we have but few, most of them being manufactured or requiring skill and care in preparing, collecting or keeping,—the following are the principal:—

- 1st. Guano mixed with decayed vegetable matter or wood ashes, when necessary.
- 2d. Animal matter, such as dead beasts, blood, fish offal, &c., made into compost with peat or other vegetable matter, the bones being reduced to soluble phosphate and sulphate of lime, by Sulphuric Acid.
- 3d. Human excreta, gypsum and vegetable matter, the organic acids of which combine with the ammonia.
- 4th. Farmyard dung, gypsum, if lime be necessary, saturated with the liquid excreta.

The above manures, if added in sufficient quantity, force good crops without leaving the soil poorer than before adding them; and are, therefore, manures for the soil as well as for the crops.

The following substances are in manures:—

MINERAL, Lime, Magnesia, Silix, Soda, Potash, Salt, and other Chlorides, Sulphuric Acid, and

* NOTE.—Lime, though absolutely necessary for the growth of certain plants, must not be considered as a Manure proper, for a soil rich in lime may become as barren as one deficient in that substance.

other compounds of Sulphur; and with clayey animal composts, Alumina and Iron.

ORGANIC OR GASEOUS, Oxygen, Hydrogen, Carbon, and Nitrogen.

Of these latter elements, plants favorably circumstanced, and in vigorous growth, absorb the greater portion of what they require by their leaves; and this they appear to be better able to do when manures, containing these elements, are supplied to their roots. The most important and valuable of the above are Phosphoric Acid and Nitrogen.

Chemists, after many experiments, have fixed the present agricultural value of all the constituents of manures, and thus their true commercial price will, with very slight variation, be the same in every country.

PRICE PER TON.

Nitrogen,	£131	0	0	currency.
Ammonia,	90	0	0	"
Phosphate of Lime,	12	0	0	"
Alkaline Salts,	1	10	0	"
Organic Matters,	1	10	0	"
Sulphate of Lime,	1	10	0	"
Soluble Phosphate of Lime,	36	0	0	"

MAGNESIA, lime and silex, of no value as manures proper.

Taking the amount of Phosphoric Acid and Nitrogen, &c., as representing the value of manure, we shall see by comparing the analysis, the

relative value of the four manures before mentioned.

1st. Guano, with which the Railroad will doubtless soon make the farmers of Prince Edward Island familiar.

Moisture,	15.82
Silica,	1.46
Phosphate of Lime,	19.52
Phosphoric Acid,	3.12
Alkaline Salts,	7.56
Organic Matter,	52.52
{ Of which Nitrogen,	14.29
{ Equal to Ammonia,	17.32
	100.00

According to table of values worth, per ton,
£21 2s. 9d., currency.

2nd. Animal composts, these will, of course, vary in proportion to the amount of soil, &c., mixed with the animal remains, and the character of the latter.

Liquid blood contains about 3 per cent of Nitrogen. Flesh is rich in Nitrogen, Phosphoric Acid, Potash, &c. Fish offal, which may be easily procured in some parts of the Island, contains—

Moisture,	80.89
Phosphate of Lime,	3.86
Alkaline Salts and Lime,	1.00
Organic Matter,	14.25
{ Of which Nitrogen,	1.92
{ Equal to Ammonia,	2.33
	100.00

Worth, per ton, £2 18s. 0d., currency.

3rd. Human excreta, like those of farm animals, vary according to food in the quantity of fertilizing constituents, an ordinary sample contains $\frac{3}{4}$ lbs. Moisture, Nitrogen, Oxygen, Carbon, Hydrogen, and some Phosphates, supplying valuable nourishment to plants. Its average value is about, per ton, £1 10s. 0d.

4th. Farmyard manure, a good sample from well fed animals, yielded—

Moisture,	75.42
Phosphate of Lime,	0.35
Alkaline Salts and Lime.	1.12
Sand,	6.58
Organic Matter,	16.53
{ Of which Nitrogen,	0.606
{ Equal to Ammonia	1.164
	100.00

Value, £0 13s. 0d., per ton, currency.

The relative value of the manures is as follows:

1	Ton of Guano, (Peruvian).
33	Tons of Farmyard Dung.
21	“ of Horse Dung.
38	“ of Cow Dung.
22	“ Pig Dung.
14	“ Mixed Human Excrement.
7	“ Fish Offal.

Let us now review our resources in manures, leaving Guano, Gypsum, and Bone Dust aside until we are provided with the means of trans-

port. It is well known that no farm can supply sufficient farmyard dung, however numerous the live stock, and as it is impossible to return in dung what the animals consume, or sufficient to enable plants to draw what is required from the atmosphere, the feeding of animals, if their bodies be sold off the farm must, if no other manure be brought on to the farm, end in exhausting the soil.

It will be seen that our resources are but scant, and the writer considers that the introduction of Artificial Manures, will be one of the greatest benefits the Island will derive from its Railroad.

We have 100,000 inhabitants, whence the animal excreta would amount to about 2,000 tons per annum, a great portion of which is allowed to be lost, could afford manure to the value of £3,000, per annum, that is to say, at purchasing price. The ultimate value of manures, by effects on the crops, is, of course, considerably greater, and constitutes the farmers profit on his outlay.

Animal composts are rarely seen in this Island, and can be but occasionally made; there is a general neglect in this particular. Dead beasts, equal in value to many tons of farmyard manure, rot in creeks and out of the way corners, not only wasting valuable manure, but making the place unpleasant and injurious to the health of the inhabitants.

The land can supply us with Farmyard Dung, Human Excreta, Wood Ashes, and Animal Com-

posts. The sea with Kelp, Fish offal, in some localities, and the Shell Muds. To the examination I have made of the latter, I will now draw the readers attention.

SHELL OR MUSSEL MUD.

Every digger of mud must have noticed the different appearance which it presents in various localities and depths; its chemical and mechanical composition and value as a manure differ no less. It would be of great advantage to this agricultural country if its Government would so far interest itself in the farmers welfare, as to have the mud from several parts of each principal creek examined, so that the farmer might with certainty take the road which would best suit his purpose, and avoid waste of labour and its attending disappointment, and the transport of a comparatively worthless material when a mud suited to his purpose might be near at hand. Such an examination extends beyond private means, through there being no probability of remuneration. I have been consequently obliged to confine myself to a few examinations, and of those have chosen for these pages, three which may be considered good types of the generality of Shell Muds.

No. 1, is from the upper end of an arm of a river into which a mill and other small streams carry some partly decomposed vegetable matter. The water was brackish to the extent of one of

sea water to two of fresh. This mud is very soft and fine, of a dark greenish hue, having none or a few living shells, except on the surface where a few oysters are sometimes found. The embedded shells are mostly broken up and decayed, and more spiral shells are found than in the other muds. It emits a strong smell of decayed matter, but acts feebly on test-papers of Lead and Silver, slightly reddens Litmus. The average depth of water over this mud was 5 feet, thickness of ice 2 feet. This mud may be considered as the type of the most valuable muds of the Island.

No. 2, is the upper mud from the main river, at about one-third of the distance from the locality of wet mud and the rivers mouth. It is the type of the shell mud found in most of our partially closed or shallow rivers, and is the variety most generally employed, and obtained perhaps in greatest abundance, still most rivers will supply an ample quantity of No. 1, as the man, from whom I obtained my samples, dug 150 load of it from a limited space, and others were taking about the same. The number 2 mud differs visibly from No. 1, in having less vegetable matter, more living or recently dead shells, (oysters and mussels), less spiral shells, more sand, and less finely divided mud, and in its less greenish color. It contains many large oyster shells, and is altogether of a coarser texture. Depth of water at which it is got is from 5 to 8 feet.

No. 3, is the mud taken from the same hole as

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No. 2, but at a greater depth, in fact after all of No. 2 had been removed. The diggers either preferred taking this mud to digging a new hole, or were not at the time provided with the necessary tools. A reference to the analysis will shew that this mud, owing to its great percentage of coarse sand and large shells, is of a most inferior description, and almost valueless on light soils.

It consists of very large and partly disintegrated oyster shells, with few mussel shells, little organic matter and fine clay, and much sand, but was richer in Phosphoric Acid than the preceding.

A compound like the mussel mud must be expected to vary under very slight alteration of conditions, such as age, nature and depth of water, position as regards proximity to the mouth or source of a river, &c., and it is only by examining many specimens that a fair knowledge of its varieties can be obtained.

Preliminary examination showed that the amount of water raised and transported in the mud was very great, and actual weighing proved that No. 1 mud, as raised by the digger, was capable of holding nearly 76 per cent, *i. e.* 75.83, so that out of every 4 tons of mud put into the sleigh 3 tons were water. The coarser varieties of mud held less water.

The shells alone held according to their state of disintegration from 5 to 7 per cent.

As a rule, the more water held the more finely divided and more valuable is the mud, this and the extra amount of Alkaline Salt compensates for the labor of transporting so much water. We shall, further on, enquire whether the landing the mud at the nearest shore and transporting it after draining to the fields, is preferable to carrying it direct from the diggings to the land intended to receive it.

The analysis of the different muds of which I present the three I consider most typical are arranged in a tabular form, which will show the mechanical and chemical composition at the same time, progressing from mud and water to their various constituents.

We will now see what substances, (and how much of each) are put upon the land, in 200 loads or 100 tons of No. 1 mud, supposing it to be taken directly from the machine to the fields.

In No. 1, we have, in round numbers, 76 tons of brackish water, containing 15 cwt of Alkaline Salts, $9\frac{1}{4}$ tons of Carbonate of Lime or Shells, $7\frac{1}{2}$ tons of Clay, $3\frac{1}{2}$ tons Sand, 2 tons of Sulphate of Lime or Gypsum, from reaction of Oxidized Sulphide of Iron upon the lime, 1 1-5 tons of Dry Organic Matter, equal to at least 5 tons of good vegetable mould, about 20 lbs. of Phosphoric Acid, and 36 lbs. of Ammonia, — NH_3 — principally as Nitrogen.

With the help of the table of values before given we will estimate the worth of this mud as manure, and also examine it as a mineral improver of the soil, as regards its lime and clay.

NOTE TO TABLE ON PAGE 11.—It was not considered necessary to take the Gases in solution into account, as they would escape before the mud was applied, and would be of no practical importance.

The loss is probably water, which is not easily driven off from the mud without decomposing its organic matter, it may be divided equally amongst the several constituents, or in part attached as Acid to the Magnesia, and amounts to 0.14 on 15.06.

The Sulphide of Iron, which exists in the recently dug mud speedily decomposes on exposure to air and moisture, by absorbing Oxygen, forming Sulphate of Iron, which acts upon the Carbonate of Lime, giving Sulphate of Lime or Gypsum, which acts so beneficially upon clover and the grasses. In estimating the value of muds, the Sulphur should be calculated as Sulphuric Acid in Sulphate of Lime,—that being its ultimate condition.

PER 100 TONS.

Currency.

15 cwt. Alkaline Salts, at £1 10s., per ton,	£1 2 6
1 1.5 tons Organic Matter, at £1 10s., per ton,	1 16 0
2 tons Sulphate of Lime, at £1 10s., per ton,	3 0 0
20 lbs. Phosphoric Acid, or 44 lbs. Phosphate of Lime, at £12, per ton,	0 6 3
36 lbs. Ammonia, at £90, per ton, or 9½d. per lb.	1 8 6
	£7 12 3

Say equal to 1s. 6d., per ton, currency, as manure.

The value of the lime and clay when predominating will vary according to the situation of the farm. Lime may be easily obtainable in some parts, and more economically applied as such than as mussel mud. After frequent enquiries, I consider £2, per ton, may be considered as the average price for lime for the whole Island, and in relation to its varying price, the comparative value of the lime in mud can be easily calculated for any district.

Its value as applied to the soil in mussel mud will, under certain circumstances, not agree with the market price, for if the soil already has sufficient lime, its value will be nothing. To a soil

deficient of lime, its value as Carbonate of Lime, slowly supplying the soil with lime, will still be but small, I would say not exceeding the 1-20 the value of burnt lime,—say 3s. per ton of shells in the mud. If sifted and burnt, the lime and wood ashes would be worth the full price of the best lime, for agricultural purposes. But in their rough state their value is considerably impaired by the extreme slowness with which they break up, and incorporate with the soil.

The next sample of mud was from the main river, about three miles nearer to the sea, the water here was still brackish, but in a much slighter degree than from where No. 1 was taken. The specimen was taken from the sleigh immediately after raising, and drained to the same extent as No. 1. Live oysters and mussels occupied the surface, the former mostly single and not so old as in the beds which yield our ordinary supplies.

NOTE.—In estimating the amount of shells, a portion of mud was washed through a sieve of 100 meshes to the inch, all fragments of shells that could not pass through were reckoned as shells, the finer particles being afterwards estimated as Carbonate of Lime.

ANALYSIS OF SHELL MUD.—No. 2.

100 parts	WET MUD.	WET SHELLS.
consists of—	80.87	19.13
	DRY MUD.	DRY SHELLS.
	37.13	18.12
consisting of * Salts.	Alumina.	Silica.
17.0 being coarse Sand.	7.25	23.95
	Carbonate of Lime.	
	0.51	
	Sulphide of Iron.	
	1.88	
	Carbonate, & Oxide of Iron and Magnesia.	
	Magnesia Carb.	
	Salts.	
	Organic Matter.	
	Ammonia.	
	Phosphoric Acid.	

NOTE.—The Ammonia is here calculated in proportion to the Organic Matter, in accordance with the amount found in Analysis No. 1, in which the Nitrogen as Ammonia, was estimated by *Ca*da Lime in the combustion tube.

In 200 loads or 100 tons of this mud, we have about 44 tons of water, containing $17\frac{1}{2}$ cwt of Alkaline Salts, $25\frac{1}{2}$ tons of Carbonate of Lime, a little more than 1 ton of Sulphate of Lime, $\frac{1}{2}$ ton of Dry Organic Matter, 127 lbs. Phosphate of Lime, and 16 lbs. Ammonia.

VALUE AS MANURE PER 100 TONS.

$17\frac{1}{2}$ Cwt. Alkaline Salts,	£1	6	3	currency.
1 Ton Sulphate of Lime,	1	10	0	"
127 lbs. Phosphate of Lime,	0	13	7	"
$\frac{1}{2}$ ton Organic Matter,	0	15	0	"
16 lbs. Ammonia, at $9\frac{1}{2}$ d per lb.	0	12	8	"
	£4	17	6	

Equal to per ton $11\frac{3}{4}$ d.

In this mud there is the advantage of a large proportion of finely divided Shells or Carbonate of Lime, and the disadvantage of a large proportion of sand, about 20 tons, there is less Organic Matter, and less Ammonia, but more Phosphoric Acid.

The value of the lime as shells may be added to this amount, taking price of lime in neighbourhood.

The third sample was taken from the hole from which No. 2 had been previously extracted, being in fact the lower part of No. 2. It was a coarser and more sandy mud than either of the preceding, contained many large oyster shells and yielded by analysis, as below.

In 100 tons of this mud, we have 36 tons Water, 13 tons Carbonate of Lime, about $1\frac{1}{2}$ tons Sulphate of Lime, 15 cwt. Alkaline Salts, 360 lbs. Organic Matter, 90 lbs. Phosphoric Acid, 6 tons Clay, and about 40 tons Sand.

After the scale of prices before given, its value, as manure, will stand thus:—

Alkaline Salts, 15 cwt.,	£0 15 0
Sulphate of Lime, $1\frac{1}{2}$ ton,	1 10 0
Phosphate of Lime, $1\frac{3}{4}$ cwt.,	0 14 0
Organic Matter, $3\frac{1}{4}$ cwt.,	0 3 6

£3 2 6

Value per ton, currency, $7\frac{1}{2}$ d., to which may be added the Lime.

The inferiority of this mud consists in its having very little fine Carbonate of Lime, and in 40 per cent of the wet mud being sand, which, with the large oyster shells, would tend to render the light soil of Prince Edward Island still more porous and sandy. In comparing these muds, we ought, undoubtedly, to give the preference to the least sandy, for in their other components the variation is not so marked.

No. 1 has $3\frac{1}{2}$ to 4 per cent sand,

No. 2 has 22 " "

No. 3 has 40 " "

There can be no doubt that the addition of so much sand as is contained in No. 3 would more than negative the ameliorating properties of the other component parts of the mud.

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The Table below shows the important constituents of the three muds compared :—

IN 100 PARTS.	1	2	3	AVERAGE.
Water,	75.83	43.87	35.61	51.79
Alkaline Salts,	0.75	0.88	0.72	0.78
Sulphate of Lime,	2.10	1.00	1.50	1.83
Phosphate of Lime,	0.02	0.05	0.08	0.05
Carbonate of Lime,	9.34	24.80	12.50	15.21
Org. Mat. & Ammonia,	1.20	0.55	0.16	0.64
Sand,	3.50	22.00	40.00	25.17
Clay,	7.50	4.50	6.00	6.00
Value as manure, without lime, per 100 tons,	£7 12 3	£4 17 6	£5 2 5	£5 4 1
		Currency		

Mussel Mud is sometimes applied to the land in its wet state, but more frequently is landed at the nearest convenient point and allowed to drain and dry, this with rain and the thawing of the snow, will remove most of the alkaline salts. We may safely assume that we lose, by this treatment, two-thirds of the water and salts.

We will examine the composition of No. 1 Mud, thus treated. No. 1 Mud contains 75.83 per cent. water; two-thirds of this would be 50.56, say one-half of the whole. The other components, with the exception of the alkaline salts, would thus be doubled in every ton, and the value of every 100 tons would stand as follows :—

5 cwt. Alkaline Salts,	£0 7 6
2 2-5 tons Organic Matter,	3 12 0
4 tons Sulphate of Lime,	6 0 6
88 lbs. Phosphate of Lime,	0 12 6
	£10 12 0

Mud, when piled on shore, is frequently left during the summer, the nitrogenous matter furnishing ammonia is decomposed, and, to a great extent, lost; the ammonia has, therefore, been omitted in the above calculation. The estimate represents the value of two hundred tons of No. 1 Mud, concentrated to 100 ton by drying and draining.

200 tons of No. Mud is worth	£15	4	6
Dried and drained to 100 tons,	10	12	0
Loss in value of mud,	£4	12	6

The farmer will be the best judge, according to the situation of his farm, as to the comparative advantage or disadvantage of losing £4 12. 6d. on every 200 tons by draining the mud, or employing the labor of man and horse in hauling 200 tons, instead of 100,—bearing in mind that if the drained mud be hauled to the fields before summer heat has decomposed the nitrogenous matter, the above loss will be diminished by the value of the ammonia saved. No soluble salt of ammonia was detected by Nessler's test in the water saturating the newly-dug mud.

It is hoped that the preceding pages will suffice to give a general idea of the value and properties of mussel mud. The space at disposal will not admit of more examples. If what is here offered be received with approbation, more extended researches into the nature of the soil in

different parts of the Island, and the mussel and other muds contiguous, may be attempted.

Cost of raising mud by the present method, supposing horses to be otherwise idle, and therefore not chargeable in this estimate, the expense of digging and landing 200 loads, or 100 tons, of mud, would be about as follows:—

Wear of machine and interest on cost,	£1	0	0
20 day's hire of 2 men at 4s.,	8	0	0
Wear of sleigh and horse shoes,	0	10	0
Interest & sinking fund on horses,	0	6	6

Est. furnished by farmers of P.E.I., £9 16 6

Mussel mud may be bought at from 1s. 6d. to 2s. per ton at the digging machine, and this price arrived at by practice is almost identical with its value as estimated by experiment, for if to £7 12s. 3d., the value of 100 tons No. 1 Mud as manure, we add the lime, we shall come but little beyond of the £9 16s. 6d.; but as it costs as much to raise the inferior muds as the better sort, it would appear that actual loss is sustained by raising the former. There is hardly a river in Prince Edward Island in which several varieties of mud will not be found. That in the arms and creeks will always differ from that in the main stream, and directions for the discrimination of the various muds will be given further on, involving no chemical experiments, but still it is hoped sufficient to guide any intelligent farmer.

In many parts of our rivers large beds of mussels are to be found. A farmer having such a bed near him, would find, in the flesh of the mussel, a manure quite equal to fish offal. They should be ploughed in, or spread before harrowing, or better still if applied just before sowing. Mussels do not occur in sufficient quantity to be generally used, but no farmer should neglect such valuable manure when it is near at hand. Mussels, fish offal, and indeed all fresh animal matter, are more easily divided and applied after having borne their part in the formation of compost. The preparation of fish offal and such other matters, as an easily scattered manure, is attended with great difficulties. They putrify before they can be dried and pulverized, and although several patents have been obtained for various processes having that end in view, none seem to have established a firm footing. Their employment in composts appears to be the most practical, especially in Prince Edward Island. Such composts, properly prepared, rank high as manure, far exceeding the best samples of mussel mud.

To a soil so deficient in lime, and so porous and sandy as Prince Edward Island, the mussel mud, when clayey, is a great boon. Moreover, our numerous rivers and inlets furnish an ample supply; but when, by its use, the soil has acquired a sufficiency of lime, it is time to examine closely

into the effect produced by adding more mud. It must be evident to all that the continued addition of large oyster shells, which take many years to break up, would be productive of more evil than good; and yet were these eliminated, the addition of such mud as No. 1, to almost any extent, would continue to benefit the soil. We must, therefore, conclude that the proper course to adopt is, after the soil has been amply supplied with lime, to sift the mud, apply the finer parts as manure, and burn the shells, which, with the ashes of the wood employed, should be used to lime other soils deficient in that respect, which it will do much more efficiently and rapidly than when applied as rough shells. By using the mud in this manner, we may lime the new land and manure the old. But we must not deceive ourselves as regards the results. It is impossible to raise a crop without food for the plant, and if Prince Edward Island will have good crops, it must expend sufficient in plant crop. The value of mussel mud, per ton, as manure, has been stated. The value of manure added per acre in other countries, where good crops are raised, can be ascertained by all who choose to make the enquiry. The writer has been informed by an English farmer that £9 currency per acre is sometimes expended in manure for wheat. This may perhaps be taken as the maximum; but if we take £2 per acre as the average, we should require, in sifted mussel mud of No. 1 quality,

26 $\frac{1}{3}$ tons, or say 50 loads per acre, and this quantity, alternating with farmyard manure, in potatoe and turnip crops, would ensure as good an average state of cultivation as the soil and climate of the Island will at present allow. Now, when it is considered that in manuring value, (that is disregarding lime), one ton of genuine Peruvian guano is equal to 280 tons of mussel mud of the best quality, and that the expense of digging and landing that quantity is £27 10., compared with £21 2s. 9d., the price at which guano could be delivered at Charlottetown, the labor saved in employing the latter, as well as the £6 cash, strongly recommend its employment. It is to be hoped that when the railway is opened, guano, superphosphate of lime, and other manures will be constant freights. It is also to be hoped that the farmers of the Island will not be deceived by the spurious manures which will be sure to find their way here, as they have elsewhere, and that the Government will have all such cargoes examined and certified before they are sold. Artificial guanos have been offered for sale in England at £10 sterling per ton, though not worth more than £2 10s. as manure.

MECHANICAL COMPARATIVE EXAMINATION OF MUSSEL MUD.

The following remarks are intended to furnish the farmer with a simple means of determining

the relative value of shell muds, avoiding all chemical experiment. They are based upon the physical properties or mechanical division of the most bulky ingredients; and as the more valuable and minute constituents of mud have been found by the previous experiments to occur in various proportions, regulated by or accompanying certain mechanical composition, the rules laid down are expected to answer all practical purposes.

On reference to the analysis before given, it will be seen that the mud containing most water contained also the most valuable manure, and although there was an apparent loss of time and money in transporting so much water, the value of the manure put upon the land in any given quantity was greater than in a mud containing less water. It was also found that as the quality of a mud, as manure, deteriorated, the amount of water capable of being held by it decreased.

We have here one simple test—the amount of water a mud can hold without dripping—which we will call

FIRST EXAMINATION—WATER.

Take from the sleigh, of the mud just thrown from the digger, and drained so as hardly to drip, or drip slowly, a fair average of about 6 or 7 lbs., which carry home in a tin or earthen vessel; weigh from this, taking care to have fair average 1 lbs, which place in a glazed earthen vessel,

previously dried and weighed, in a common oven, and dry gradually, taking care to break between the fingers all clayey lumps as they form. When so dry that the adhering mud can be brushed off from the shells, and the clay appears as a dry powder, or small lumps easily crushed between the fingers without feeling damp, weigh the vessel and contents, and note weight; replace in the oven, and after $\frac{1}{4}$ hour weigh again. If the weight is the same, the mud is dry; if the weight be less, the drying must be continued until two weighings, made with an interval of $\frac{1}{4}$ hour between, are alike. The loss in weight is to be calculated as water. The temperature of the oven should not be quite so high as required for baking bread. From 8 to 24 hours will be required for thorough drying, the sandy muds drying most rapidly. From the weight lost by the four pounds of mud, the percentage is easily calculated, and its quality as No. 1, 2, or 3, or intermediate, fixed in that respect.

SECOND EXAMINATION—SHELLS.

Procure a piece of iron wire netting, 8 or 10 inches square, having 100 meshes to the square inch, which may be obtained at nearly every store; bend it so that it forms a kind of funnel. Take from 2 to 4 lbs. fair average mud, and wash and stir in sufficient water to make it fluid; ladle and pass it through the sieve, washing it until the shells and fragments of shells are clear.

The larger shells may be washed and removed as convenient. These and all the smaller fragments in the sieve are to be dried until they cease to lose weight, and reckoned as shell or coarse carbonate of lime.

THIRD EXAMINATION—SAND.

The fluid mud washed through the sieve, in examination No. 2, contains all the components of the mud, except the coarse shell. The mud will now be mixed with about a gallon of water, perhaps two gallons, according to the washing required to free the shells from mud. Allow it to subside five minutes, and pour away the water taking care to lose no sand, or other solid matter, except such as will be in suspension (organic matter and finely divided clay which will take a long time to sink). Place the residue in a large glass jar—a one gallon glass lozenge jar will answer—and nearly fill with water, cork and shake, and allow it to rest two minutes, pour off the water and fill again, shake, and allow it to rest one minute, pour off, and again fill, allow to rest half minute, and repeat this until the water ceases to be muddy, and the sand and finer parts of shells are washed clean. The solid residue is then to be dried in the oven until it ceases to lose weight, and may be reckoned as sand.

The finely divided shell can only be separated from the sand by chemical means, and there-

fore in this mechanical examination must be disregarded. The water, lime as shells, and sand being ascertained, a reference to the tables before given, page 19, will enable the farmer to form an appropriate valuation of the mud examined. Thus in regard to water, the nearer the amount reaches 75 per cent. the nearer it will resemble No. 1 Mud in value. If the water ranges between 40 and 30 per cent., then its value will be less, and the mud will be either of second or third quality. This, of course, applies to its value as manure when applied to land already limed. If liming be the object in view, then the examination No. 2 will alone have to be the guide; but in using a mud rich in lime care should be taken that it be not too sandy; should such be the case, it will be more profitable to sift the mud and burn the shells than to add to the soil a large amount of sand.

REMARKS UPON METHOD OF OBTAINING MUSSEL MUD.

We have before referred to the estimate (furnished by a digger of mud) of the cost of raising 100 tons in Kildare River, if the expense varies in other localities, the reader can make the necessary allowances in the estimate.

Although the plan at present adopted in digging mud yields very fair results, the writer thinks that several improvements may be made which would reduce the cost of the mud by obtaining it in much less time. At present much

time and labour are expended on cutting holes in the ice which seldom exceed 10 by 8 feet, and in endeavouring to raise as much as possible from each hole, the inferior sandy muds lying low are frequently taken, whereas, if a considerably larger hole were made by blasting with powder, the machine might work round it and take only the upper or best muds, and much time would be saved by not having to cut the ice. A slight alteration would be required in the fore part of the base of the machine. At present it rests entirely upon the ice, on the plan proposed it would project over the hole in the ice and should have a small platform attached for the manager of the fork to stand upon. The other end of the base of the machine would have to be a little longer, and boarded for the horse, so as to effectually counterbalance the weight projecting over the water. A machine thus constructed could be shifted round the hole, and the labour of cutting many holes be avoided.

A convenient method of blowing up the ice by powder will now be described.

The materials to be purchased will be blasting or cannon powder, and waterproof fuse such as is used by miners and quarrymen in wet places, it is about the thickness of a lead pencil, is flexible, and sold by the fathom.

To prepare the charge for blowing up the ice, a common wine bottle will make the best and

simplest cartridge, fill it with coarse powder, or if less be found sufficient according to the thickness of the ice, some saw dust or sand may be placed at the bottom, so as to bring the powder close up to the cork. The cork must be tight fitting, and have a hole bored to receive the fuse which should fit as tightly as possible, and be further secured from wet by pitch or white lead. From 6 to 10 feet of fuse will be sufficient, it should, after passing through the cork, enter an inch into the powder.

A stem of alder, or other flexible wood, about 8 or 10 feet long, like a stout fishing rod, is then to be procured, and the bottle securely fastened to its thinner end, the fuse being tied here and there to the whole length of the stick, thus :



Dig a narrow hole such as when fishing for trout, the more shallow the water the longer should be the hole. Push the rod in gently, and the thin end being more flexible, will bend and run along the bottom if it touches it, a foot of the rod with a little projecting fuse may rest on the ice. A slow match is now to be attached to the fuse taking care that it is fixed in contact with the inner combustible portion either by insertion or by a pin and moistened powder. This slow match may be made of blotting paper or lamp cotton, steeped in sol. of saltpetre, 3 or 4 inches

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should take half a minute to burn. When this slow match is lit, retire and avoid standing in front of the rod.

LIME.

In many parts of the Island burnt lime may be obtained in any quantity at about £2 per ton, loose in the cart, and when, as in new peaty or sour land, the liming of the soil is the principal object of the farmer, its employment instead of mussel mud is undoubtedly the more profitable and expeditious. Slaked with about one-third its weight of water, it quickly falls to powder, and can mix intimately with the soil, and will act rapidly in combining with organic acid, and in decomposing vegetable matter, whereas, shells will take many years to disintegrate, and are only in the mild form of carbonate of lime, capable, it is true, of combining with certain organic or other acids, but exercising very little decomposing power on vegetable matter in general. It has been stated that oyster shells can be found almost perfect buried where the natives encamped more than 100 years since. Lime in the form of shells cannot be considered to produce an effect equivalent to more than one-twentieth the quantity of burnt lime, therefore, where the immediate effect of lime is required, it is very much cheaper to purchase it than to employ and wait for the slow action of mussel mud. Where lime cannot be obtained, the sifting process may be

adopted, when, if the shells be burnt, good lime will be obtained. The burning attending clearing should always be taken advantage of; both lime for the soil, and clay for roads, and other purposes, especially for the upper portion of railway embankments, may be then easily and economically prepared.

The best manuring muds contain about 9 per cent. dry shells, which would lose, in burning, about 40 per cent. 100 tons would thus yield $5\frac{1}{2}$ tons of burnt lime, (value, £11), so that the total value of 100 tons of No. 1 Mud, thus treated, would amount to £11. If lime be the main object in digging mussel mud, the quality rather inferior in manuring value will, in most cases, yield the greatest amount. Such mud as example No. 2 contains 18 per cent shells. Under certain circumstances, or bad management, the labor and time expended in sifting and burning will exceed in value the price of lime, as without some kind of a kiln but little could be burnt at a time. It is, however so easy to construct a rough kiln, that neighboring farmers would do well to build one for common use.

Lime, although sold at a fixed price, differs exceedingly in agricultural value. Some varieties may be procured from nearly pure carbonate of lime; others may contain so much caustic magnesia as to be injurious to the crops; while other specimens may be rich in phosphate of

lime, and be worth much as manure as well as lime. In Europe most of the younger practical farmers have sufficient elementary knowledge of chemistry to ascertain these and such like facts for themselves; and there would be no difficulty in having such useful instruction afforded in the schools of this Island.

Superphosphate of lime, a most valuable manure, could be prepared to some extent in this country if all bones were collected and impost removed from sulphuric acid.

Sulphate of lime (gypsum) can be easily obtained from the Mainland, and its stamping or grinding by water power is quite easy. It would be a valuable addition to our land for clover and other lime plants.

It is well known that many formerly valuable acres of cleared land have been completely exhausted of their plant-feeding matter; and unless more attention be paid by our farmers, and encouragement and facilities be afforded by the Government, the evil will continue. All duties levied upon agricultural improvements, either in the way of machines, manures, or chemicals, would be wisely shifted to luxuries. Manure and the saving of labor must ever be the chief object of the farmer's solicitude.

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